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E21B 43/017

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GB 1296699 A

(58) Field of Search
UK CL (Edition O) E1F FJB FJC
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(54) Offshore production of hydrocarbons

(57) In a method and system for production of hydrocarbons from offshore reservoirs production flow from a number of wells (XT) is collected and transferred to a vessel at the sea surface for processing of the well flow and temporary storage of hydrocarbons in tanks on board the vessel before unloading of the hydrocarbons to an adjacent tanker. The system includes two subsea manifold centres (10, 110), and there are used two vessels (40, 140) which, during normal operation, are coupled to a respective manifold centre. Between the manifold centres (10, 110) there are arranged a pipeline (PM) for transport of well flow and a cable (UM) for transfer of hydraulic/electric power and control signals. The manifold centres (10, 110) are connected to their respective vessels (40, 140) via flexible pipelines (FP) and cables (S, U) which, at their free ends, are coupled to an underwater buoy which, in use, is introduced into and secured in a receiving space at the bottom of the vessel. The system increases flexibility of operation and allows intervention in selected wells without having to halt production from the other wells.

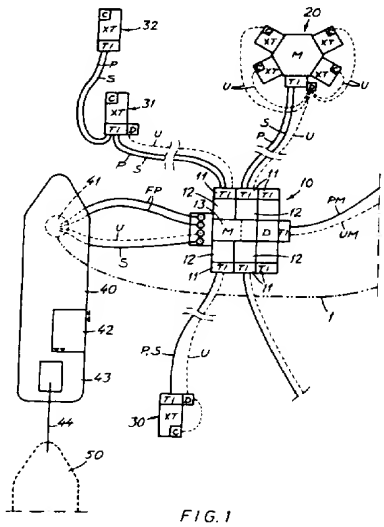

FIG. 1

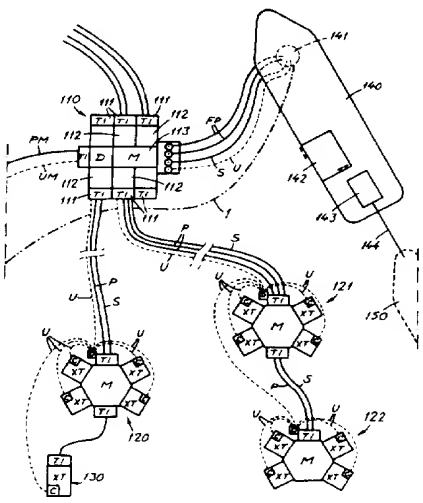

FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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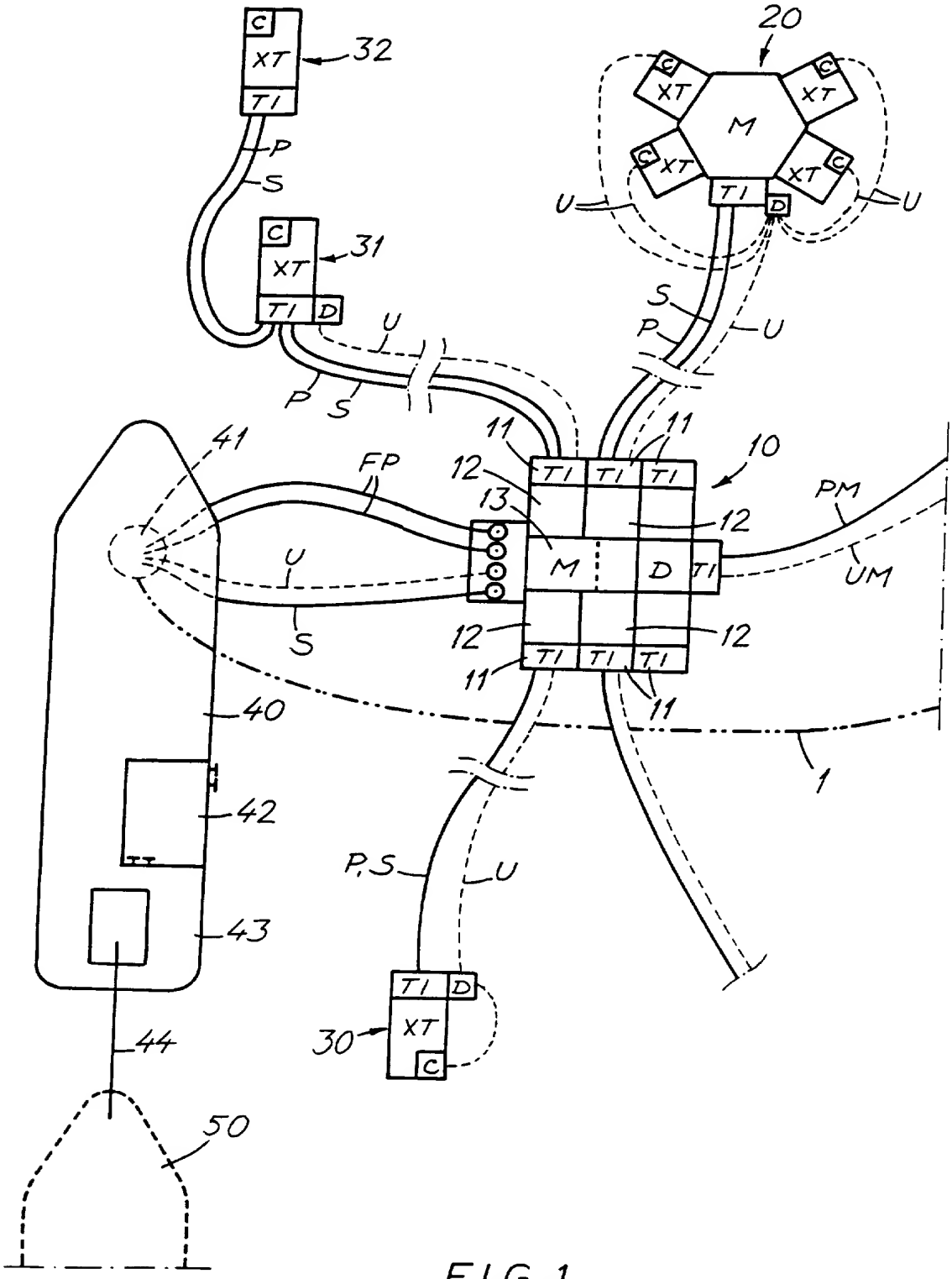
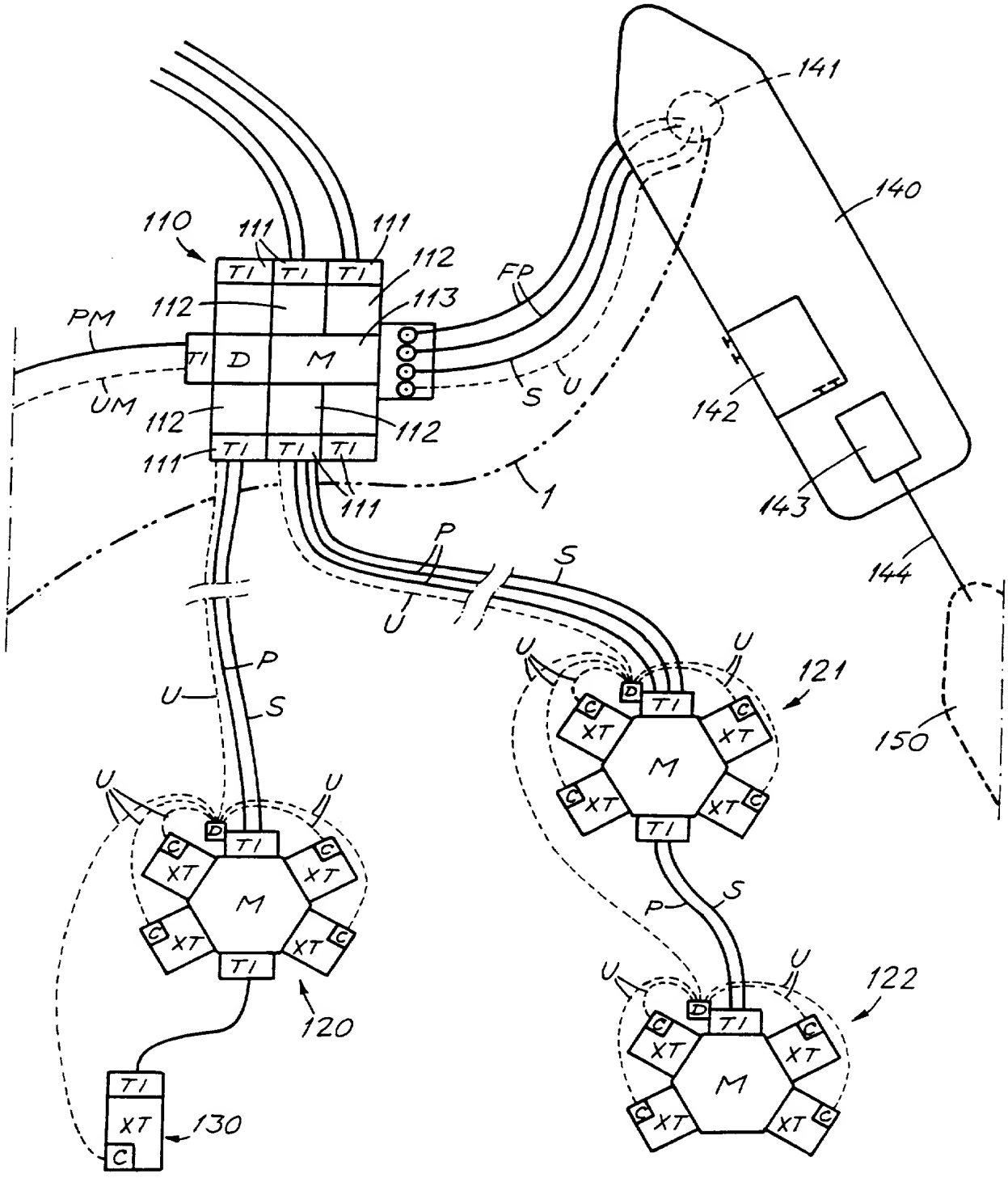


FIG. 1


110
111
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113
FP
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112
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143
144
150
P
S
U
P
U
S
U
U
U
U
121
122
120
130
XT
C
TI
M
D

FIG. 2

Method and system for offshore production of hydrocarbons

The present invention relates to a method and a system for production of hydrocarbons from offshore reservoirs, wherein subsea production wells at the sea bed are connected to a subsea manifold system at the sea bed, and well flow from the wells is transferred via pipelines to the manifold system and to a vessel at the sea surface for processing of the well flow and temporary storage of hydrocarbons in tanks on board the vessel before unloading of the hydrocarbons to an adjacent tanker.

A system of the above-mentioned type is known from international patent application No. PCT/NO95/00022 (WO 95/21091). For hydrocarbon fields wherein the wells are gathered at a small area so that one may intervene in the wells by only turning the vessel, this is a cost-efficient and good solution. When the wells have to be placed at longer distances from the vessel and one has to use a manifold system for connecting together the well flow from different subsea production systems, the development solution becomes less favourable. If problems arise resulting in that one e.g. has to intervene directly in a well, one must either call in a vessel or a rig which is able to carry out this work, or one has to shut down the production, disconnect the vessel from the underwater buoy and carry out the intervention from the production vessel. When the work has been carried out, the vessel is connected to the buoy, and one may restart the production. This process takes a long time, and one looses production while the work is being carried out.

The object of the present invention is to provide a method and a system which overcome or reduce the above-mentioned drawbacks.

According to the invention there is provided a method of the type stated in the introduction, wherein the method includes the steps of

using two subsea manifold centres, and

using two vessels which, during normal operation, are coupled to a separate manifold centre,

a pipeline for transport of well flow and a cable for

transfer of hydraulic/electric power and signals being installed between the manifold centres, and

the manifold centres being coupled to their respective vessels via flexible pipelines and cables which, at their free ends, are coupled to an underwater buoy which is introduced into and secured in a receiving space at the bottom of the vessel.

According to the invention there is also provided a system for production of hydrocarbons from offshore reservoirs, comprising a number of subsea production wells which are connected to a subsea manifold system at the sea bed, and pipelines extending from the manifold system to a vessel at the sea surface, for transfer of well flow from the wells to the vessel, the vessel being arranged for processing of the well flow and temporary storage of hydrocarbons in tanks on board the vessel, before unloading of the hydrocarbons to an adjacent tanker, wherein the manifold system comprises a pair of manifold centres between which there is installed a pipeline for transport of well flow and a cable for transfer of hydraulic/electric power and signals, and wherein each manifold centre is coupled to an associated vessel via flexible pipelines and cables which, at their free ends, are coupled to an underwater buoy which is adapted for introduction and securement in a receiving space at the bottom of the vessel in question.

The present invention is particularly advantageous in regions where the reservoir has a great geographic spreading or where it consists of several smaller reservoirs which are located close to each other. The invention is also very practicable in case of simultaneous production from two fields which are located close to each other. In the first place, one obtains a substantially increased flexibility in that the vessels are coupled together. During normal operation one produces through two separate manifold centres and to two production vessels at the surface and can have a high production, but in case of a possible shut-down of one of the vessels one may let the other vessel take over all control and reception of produced hydrocarbons.

Possibly, one may also let all electricity production take place from one of the vessels.

One may also make the transport of hydrocarbons on board shuttle tankers more efficient in that processed hydrocar-

bons from both vessels can be unloaded from the unloading equipment of one of the vessels.

All intervention and repair on underwater production equipment and wells may take place quickly and efficiently without shutting-off of the production having to be undertaken (reduced production will be necessary). To a large extent one is independent on the field.

By means of the invention one may also achieve a more flexible production in that, in the terminating phase of the field, when the production is declining, one may change from producing with two vessels to producing with one vessel.

By the solution according to the present invention one also obtains an increased reliability in that many critical components are duplicated. One has two vessels, something which implies two processing plants, two unloading plants, two power-producing units and two systems for intervention. Further, in the production, one has two independent control systems.

The invention will be further described below with reference to the drawings, wherein Figs. 1 and 2 in combination show a schematic representation of a system for production of hydrocarbons from an offshore field wherein the resources have to be extracted from several wells which are located at a distance from each other at the sea bed.

As appears from the drawings, the system according to the invention comprises two separate manifold systems or manifold centres 10, 110. Each of the manifold centres comprises connection points (TI = Tie In) 11, 111 for pipelines P for the supply of well flow from respective ones of a number of production plants forming part of the system. In connection with each connection point there is arranged a choke valve 12, 112 for choking down the well flow, so that the pressure of the well flow is in accordance with the subsequent pressure in the associated manifold (M) 13, 113.

The manifold centres 10, 110 will be connected individually to one or more subsea wells or groups of subsea wells XT (Xmas Tree) forming part of subsea production plants. In the drawings there are shown four production plants 20, 120, 121, 122 of which each comprises four wells XT which are coupled to a manifold M in each of the production plants. From three of the

production plants 20, 121, 122 the well flow goes in pipelines P directly to the associated manifold centre 10, 110.

In the Figures there are also suggested stand-alone satellite wells 30, 31, 32, 130 which may be connected to the subsea production plants 20, 120, 121, 122, or be directly connected to the manifold centres 10, 110. From the manifold centres there extend respective cables U (umbilicals) for the transfer of signals, hydraulic power and electric power for operation of the production in the subsea production plants and for operation of the stand-alone satellite wells. The cables U are connected as shown to distribution units D in the production plants (or wells), which units are connected to control moduls C of the respective wells, for opening and closing of valves in a known manner.

Between the manifold centres 10, 110 there is arranged a pipeline PM for the transfer of fluid between the manifold centres. In a corresponding manner there is also arranged a cable UM for the transfer of signals and electric/hydraulic power. As shown, the ends of the pipeline PM and the cable UM are connected to the manifold centres via respective connection points TI and distribution units D.

Well flow from all the wells which are connected to the manifold centres, is collected in the manifold 13, 113 of the associated manifold centre, and carried further through flexible pipelines FP to an associated vessel or ship 40, 140 at the sea surface.

The free ends of the flexible pipelines FP are connected to an underwater buoy (not shown) of a known type, more specifically a so-called STP buoy (STP = Submerged Turret Production) of the type disclosed in the British patent application No. 9526604.5. The buoy is connected to the vessel 40, 140 in that it is introduced into and locked in a downwardly open receiving space 41, 141 at the bottom of the vessel. In the receiving space the buoy is coupled to a swivel arrangement allowing the vessel to turn freely about the central axis of the buoy, under the influence of wind, waves and water currents. The connection arrangement for the vessel and the buoy is further described in the above-mentioned patent application, and for a further description of the arrangement reference is made to this

application.

The vessels 40, 140 are also of a known type and are described i.a. in the introductorily mentioned international patent application. In a preferred embodiment at least one of the vessels includes intervention equipment 42, 142, so that, by means of the vessels, one may carry out well maintenance or intervene on subsea-installed production equipment.

At the stern of the vessels unloading equipment 43, 143 is arranged in a known manner, in order to be able to unload processed hydrocarbons through a loading hose 44, 144 to an adjacent shuttle tanker 50, 150.

At least one of the vessels will be equipped with an electric power generator for production of the electric power which is necessary on board the vessels and for operation of the equipment at the sea bed. It will be possible to transfer significant quantities of electric power between the vessels 40, 140, either through a separate power cable 1 as shown in the Figures, or through power cables going via the manifold centres to each of the vessels. The power cables are taken into the vessel via the underwater buoy.

Cables U, S for the transfer of signals, hydraulic power and electric power also extend from the vessels 40, 140 to the respective manifold centres 10, 110.

During normal operation the production will take place as shown in the drawings. Produced hydrocarbons will be produced from their respective wells and flow through the associated manifold centre and further on board the vessel for processing and temporary storage in tanks on board the vessel. At regular intervals the shuttle tanker 50, 150 will be connected to the stern of the vessel 40, 140 for transfer of load.

Traditional shuttle tankers often will have a transport capacity which is somewhat less than the storage capacity of one of the production vessels. To ensure that the shuttle tanker is filled completely up quickly and efficiently processed hydrocarbons from the other production vessel may be transferred via the pipeline FP through one manifold system, via the pipeline PM, via the other manifold system, through the pipeline FP and into the unloading system of the production vessel which is unloaded. The necessary transport pressure may be obtained from the cargo pumps

of the other vessel.

In an alternative embodiment it is also conceivable that only one of the vessels is equipped with unloading equipment.

If operation disturbances in the production or other circumstances arise which make it necessary to intervene on of the subsea production plants or in one of the wells, one will first leave the control of both manifold centres 10, 110 to one of the production vessels. All production thereafter will go to this vessel. The other vessel thereafter will release itself from its underwater buoy and will carry out what exists of necessary intervention or maintenance work. Simultaneously therewith, one will be able to maintain a production from all the wells which are not involved in the intervention work. Even if, in most cases, one has to reduce the production from many of the wells, one avoids the problems and costs involved in a total shut-down, such as flushing of pipelines in order to avoid wax and hydrate formation. One also avoids negative influences on the production properties of the reservoir.

In a corresponding manner also all production may be transferred to one of the vessels if there is a need for maintenance or repair of equipment on board the other vessel.

Patent claims

1. A method of production of hydrocarbons from offshore reservoirs, wherein subsea production wells at the sea bed are connected to a subsea manifold system at the sea bed, and well flow from the wells is transferred via pipelines to the manifold system and to a vessel at the sea surface for processing of the well flow and temporary storage of hydrocarbons in tanks on board the vessel before unloading of the hydrocarbons to an adjacent tanker, wherein the method includes the steps of

using two subsea manifold centres, and

using two vessels which, during normal operation, are coupled to a separate manifold centre,

a pipeline for transport of well flow and a cable for transfer of hydraulic/electric power and signals being installed between the manifold centres, and

the manifold centres being coupled to their respective vessels via flexible pipelines and cables which, at their free ends, are coupled to an underwater buoy which is introduced into and secured in a receiving space at the bottom of the vessel.

2. A method according to claim 1, wherein the production through both manifold centres is controlled from one of the vessels.

3. A method according to claim 1, wherein at least one of the vessels is provided with intervention equipment for execution of well maintenance or intervention on the subsea-installed equipment, and wherein one of the vessels when required is disconnected from its associated buoy and used for carrying out necessary well maintenance or intervention on the subsea-installed equipment.

4. A method according to claim 1, wherein processed hydrocarbons on both vessels are unloaded through only one of the vessels, the hydrocarbons of one of the vessels by means of the cargo pumps of the vessel being transported via the manifold centres to the other vessel for unloading therethrough.

5. A system for production of hydrocarbons from offshore reservoirs, comprising a number of subsea production

wells which are connected to a subsea manifold system at the seabed, and pipelines extending from the manifold system to a vessel at the sea surface, for transfer of well flow from the wells to the vessel, the vessel being arranged for processing of the well flow and temporary storage of hydrocarbons in tanks on board the vessel, before unloading of the hydrocarbons to an adjacent tanker, wherein the manifold system comprises a pair of manifold centres between which there is installed a pipeline for transport of well flow and a cable for transfer of hydraulic/-electric power and signals, and wherein each manifold centre is coupled to an associated vessel via flexible pipelines and cables which, at their free ends, are coupled to an underwater buoy which is adapted for introduction and securement in a receiving space at the bottom of the vessel in question.

6. A system according to claim 5, wherein at least one of the vessels is provided with intervention equipment for execution of well maintenance or intervention on the subsea-installed equipment.

The Patent Office

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Application No: GB 9605439.0 **Examiner:** David Harrison
Claims searched: 1 to 7 **Date of search:** 15 May 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): E1F (FJB, FJC)

Int Cl (Ed.6): E21B

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1296699 (Ocean Systems Inc.) see Fig 1	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.